CLAIMS

1. A method of producing chaotic mixing to effect an entire volume of a liquid in a container, comprising:

inserting a magnetic stir bar into the container so that it is generally vertically oriented, the stir bar having a length greater than an internal diameter of the container or one half of a depth to greater than the depth of the liquid in the container;

creating an erratic stirring pattern of the sir bar in the liquid by separately activating at least one magnetic field to act on the stir bar in one or more dimensions.

2. The method of claim 1, further comprising applying the at least one magnetic field to cause generally vertical up and down movement of the stir bar.

3. The method of claim 1, wherein there are a plurality of magnetic fields that are formed by a plurality of controllable magnetic drives located in proximity to the container, and the method further comprises changing an energizing sequence of the magnetic drives by at least one of stopping, reversing, and random sequencing of the energizing sequence to create chaotic and gentle mixing action of the liquid by horizontal movement of the vertical stir bar.

4. The method of claim 3, wherein the energizing sequence is stored in a controller and is repeatable.

5. The method of claim 3, wherein the energizing sequence can be programmed for at least one of a particular container size or a particular type of liquid being mixed.

6. The method of claim 3, wherein the energizing sequence first causes the stir bar to create a first flow pattern in the liquid, and then changes the movement of the stir bar to interrupt the first flow pattern causing turbulence.

7. The method of claim 3, further comprising providing the magnetic drives as inductor cores which extend from inductor coils into proximity with the container.

8. The method of claim 3, wherein four magnetic drives are provided for the container arranged as opposing pairs, the energizing sequence comprises:

energizing pair one (A-C) in a forward direction and not energizing pair two (B-D);
energizing pair two (B-D) in the forward direction and not energizing pair one (A-C);
energizing pair one (A-C) in a reverse direction and not energizing pair two (B-D); and
energizing pair two (B-D) in the reverse direction and not energizing pair one (A-C) to turn the stir bar one revolution.

9. The method of claim 3, wherein four magnetic drives are provided for the container, and the magnetic drives are selectively energized.

10. The method of claim 3, wherein the magnetic drives are energized so that the stir bar is rotated at a speed of at least 10 rpm.

11. The method of claim 1, further comprising providing the stir bar with an L-shape.

12. The method of claim 1, further comprising providing the stir bar having at least one end that is lighter than the liquid that is being stirred so that the stir bar stands generally vertically and/or is suspended in the liquid.

13. The method of claim 1, wherein the magnetic fields are formed by a plurality of controllable magnetic drives located in proximity to the container, and the method further comprising heating the container and the liquid therein using heat dissipated by the magnetic drives.

14. A stirrer for chaotic stirring that affect an entire volume of a liquid in a container, comprising:

a plurality of magnetic drives located in a housing;

a controller that selectively actuates the magnetic drives in accordance with an actuating sequence;

a holder for the container located on the housing in proximity to the magnetic drives; and

a magnetic stir bar having a height greater than an internal diameter of the container or one half of a depth to greater than the depth of the liquid located in the container, the magnetic stir bar is generally upright and moves in response to the magnetic drives being actuated to chaotically stir the liquid in the container.

15. The stirrer of claim 14, wherein the magnetic drives comprise inductor coils and inductors arranged in an array, the inductor coils being individually energized by the controller.

16. The stirrer of claim 14, further comprising a coil plate to transfer heat from inductors of the magnetic drives to the holder, and a thermostat and a fan located in the housing for temperature control of the container and holder.

17. The stirrer of claim 14, wherein the holder is an incubation block.

18. The stirrer of claim 14, further comprising an opening in the housing above the magnetic drives in which the holder is inserted, which is adapted to receive a plurality of holders having different configurations.

19. The stirrer of claim 14, further comprising a manual speed control connected to the controller.

20. The stirrer of claim 14, wherein the stir bar is L-shaped.

21. The stirrer of claim 20, wherein a horizontal leg of the L-shaped stir bar has a length less than ¾ of the internal diameter.

22. The stirrer of claim 14, wherein the stir bar includes at least one end that is lighter than the liquid that is being stirred so that the stir bar stands generally vertically and/ or is suspended in the liquid.

23. The stirrer of claim 14, wherein the stir bar has at least one of an asymmetrical shape, an eccentric weight, ribs or flutes.

24. The stirrer of claim 14, wherein the stir bar comprises a permanent magnet located in one end of a sealed polymeric tube.

25. The stirrer of claim 14, wherein the stir bar has at least three generally flat sides.

26. The stirrer of claim 14, further comprising a mixing simulator connected to the stirrer that includes a plurality of magnetic drives positioned to allow observation of a simulator container during mixing, the simulator magnetic drives being driven by the controller according to the same actuating sequence of the stirrer magnetic drives.

27. The stirrer of claim 14, wherein the magnetic drives include inductor coils and electromagnetic inductors that extend from the coils into proximity of the container.

28. The stirrer of claim 27, wherein the electromagnetic inductors extend into openings defined in the holder in positions located around sides of the container location.

29. A magnetic stir bar adapted to be oriented generally vertically in a container of liquid to be stirred, comprising a permanent magnet located at one end of a polymeric member.

30. The magnetic stir bar of claim 29, wherein the polymeric member is flexible.

31. The magnetic stir bar of claim 29, wherein the polymeric member is a tube, and the permanent magnet is sealed inside the tube.

32. The magnetic stir bar of claim 29, wherein the polymeric member is generally L-shaped, having one generally horizontally extending leg that is adapted to be on a bottom of the container, the magnet being located on within or in proximity to the horizontally extending leg.

33. The magnetic stir bar of claim 29, wherein the stir bar has at least one end that is lighter than the liquid that is to be stirred so that the stir bar stands generally vertically and/or is suspended in the liquid.

34. The magnetic stir bar of claim 29, wherein the stir bar has at least one of an asymmetrical shape, an eccentric weight, ribs or flutes.